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New Turf Insecticides and IRAC classifications

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Using insecticides preventively in an IPM program for turf

There are many components to an IPM program, including monitoring for pest activity, establishing tolerance levels, and considering cultural and biological control strategies. IPM supports the use of insecticides when a pest population exceeds a threshold level. Turf insecticides differ in efficacy against pests, residual duration, and whether the insecticide is a contact or systemic. For managing white grubs, care must be taken to ensure that the insecticides, such as imidacloprid (Merit) or chlorantraniliprole (Acelepryn), are applied when the grubs are in the most susceptible stage. In certain instances, however, preventive pesticide applications may be preferred to the alternative of waiting until a problem develops, especially when a problem occurred in the same area the previous year.

For example, several turf insecticides, including the neonicotinoids and chlorantraniliprole (Acelepryn), provide preventive protection against white grubs and are much less toxic than the older organophosphates that were used for many years. There are not many cultural practices or effective biological control agents that provide reliable control of white grub populations. To be justified in an IPM plan, preventive insecticide applications must be based on scouting or other documentation of the potential for damaging populations from the previous season or seasons.

Insecticide resistance

There are several chemical classes of insecticides available to turf managers. Recently the annual bluegrass weevil (ABW) has developed resistance to the pyrethroid class of insecticides. ABW has developed resistance to pyrethroids in some locations, particularly between Hartford, CT and metropolitan NY and south. One of the most effective ways to delay the development of resistance is to avoid using insecticides with the same mode of action. The Insecticide Resistance Action Committee (www.irac-online.org) has assigned IRAC numbers for each chemical class, and many chemical companies are putting these numbers on labels to make it easier for turf managers to incorporate this information into their decisions on chemical inventories.

For example, any insecticide in the neonicotinoid class (e.g., Merit or Meridian or Arena) will have a black box with a white "4A" indicating the IRAC chemical subgroup. Carbamates (class 1A) and organophosphates (class 1B) are in the same group but listed separately because while the chemistry of the two classes of insecticides is different, the mode of action (cholinesterase inhibition) is the same. Most are "older" chemicals and, as cholinesterase inhibitors, tend to be more acutely toxic to vertebrates than some of the newer insecticides. There is a lot of variation in field characteristics: Some are soluble in water while others are not; some are systemic while some are not; some are quite persistent while

some are not. For example, trichlorfon (Dylox) and acephate (Orthene) are very soluble in water and can break down quickly when water pH is above 7.5. Neither is very persistent in field conditions.

Every pyrethroid available for use on turf is virtually insoluble in water and is bound quickly to organic matter. As a result pyrethroids are effective against insects that are active in the thatch, such as annual bluegrass weevil adults, black turfgrass ataenius adults, bluegrass billbug adults, caterpillars, chinchbugs, and European crane fly. Most pyrethroids begin working three to five days after application and remain active for three to five weeks. Most pyrethroids are toxic to cats, fish and aquatic invertebrates and some are also toxic to bees that are exposed to direct treatments on flowering crops and weeds. Many pyrethroids are no longer covered by patents, so there are many other products available with different trade names.

There are four neonicotinoids (thiamethoxam, imidacloprid, dinotefuran, and clothianidin) currently available in turf, and all of them are systemic through the roots. Even though imidacloprid has been on the turf market for more than 10 years, there have been no reports of resistance in any turf insects yet. Care should be taken when using any neonicotinoid to avoid applications when honeybees are foraging, such as when clover or Creeping Charlie is in bloom. In addition, some labels indicate products are toxic to aquatic invertebrates

Some products are now available for commercial applicators that combine a neonicotinoid and a pyrethroid, but in a lower percent of active ingredient. The combination provides protection against soil insects (neonicotinoid) and surface feeders (pyrethroid). Optimal timing of application depends on what the primary insect target is at a given site. For example, if white grubs are the primary target, applications should be made just as adults become active and start laying eggs. If billbugs are the primary target, applications could be made in late May or early June to target adults as they become active. Triple Crown (FMC) contains bifenthrin, zeta-cypermethrin and imidacloprid. Triple Crown works through contact, translaminar and systemic activity. It controls ants, ticks, white grubs, annual bluegrass weevils, billbugs, cutworms, sod webworms, chinch bugs, leafhoppers, and mites.

Indoxacarb is in the oxadiazine class, which has very low mammalian toxicity and a new mode of action. It works by blocking the movement of sodium ions into nerve cells. Product labels have the same precautionary language as pyrethroids regarding toxicity to cats, fish and aquatic invertebrates, as well as foraging honeybees. Indoxacarb is particularly effective against caterpillars and is most effective when applications are made targeting eggs and small caterpillars.

Chlorantraniliprole (Acelypryn) is in the diamide class and has low mammalian toxicity and a new mode of action. Acelypryn works through contact, translaminar and systemic activity from soil to plant. The EPA did not require a signal word on the label. The label describes chlorantraniliprole as toxic to aquatic invertebrates, but it is relatively insoluble so it is

less likely to move to surface water than some other products. It is not toxic to bees, ants, or wasps. It is extremely effective against all the white grub species, but should be applied before early to mid-June to achieve maximum effectiveness against grubs. Spring applications of chlorantraniliprole will not affect grubs that are present in the spring. Acelypryn controls white grubs, annual bluegrass weevils, billbugs, cutworms, sod webworms, and chinch bugs. It has extremely low toxicity to most non-target animals including birds, fish and bees

Another newer class is the spinosyns and the active ingredient spinosad (Conserve), which is derived from a soil actinomycete. The label describes it as highly toxic to bees and to mollusks. It is effective against many caterpillars, including sod webworms, cutworms, and armyworms, as well as caterpillars in the landscape.

For ant control in Minnesota use the Advion Fire Ant Bait (indoxacarb, Syngenta, available in MN) and Maxforce Professional Insect Control Granule Insect Bait or Maxforce Complete Brand Granular Insect Bait (hydramethylnon, Clorox Co., available in MN). Note that a similarly named product, Advance Granular Ant Bait, was not as effective in trials in Kentucky. Neither bait is specifically marketed to the golf industry, but their labeling does allow use on golf courses. Spot-treating with bait allows selective control, while preserving beneficial ants in fairways and roughs. Baits should NOT be watered in after application

Synthetic Insecticide Development History					
1950	1960	1970	1980	1990	2000
DDT-Sodium Channel					
Cyclodienes- Chloride channel					
	Organophosphates-Acetylcholinesterase				
	Carbamate-Acetylcholinesterase				
		Sodium channel-Photostable pyrethroids			
				Nicotinic acetylcholine receptors-Neonicotinoids	
				Ecdysone agonist-Diacylhydrazines	
				GABA chlorine channel-Phenylpyrazoles-fipronil	
				Nicotinic acetylcholine allosteric activator-Spinosyns	
				Sodium channel-Oxadiazines	
					Ryanodine receptors-Anthranilic diamides

Common Turf Insecticides Listed by IRAC Classification, Chemical Classes or MOA

IRAC Group	Mode of Action	Chemical Classes	Active Ingredient	Trade Name ¹
1A	Acetylcholine esterase inhibitors	Carbamates	carbaryl	Sevin
			methiocarb	Mesurool
1B		Organophosphates	acephate	Orthene
			chlorpyrifos	Dursban
			trichlorfon	Dylox
2B	GABA-gated chloride channel antagonists	Fipronil	fipronil	Chipco Choice, Chipco TopChoice
3	Sodium channel modulators	Pyrethroids	bifenthrin	Allectus, Aloft, Onyx, Talstar
			cyfluthrin	Tempo
			cypermethrin	Demon
			deltamethrin	Deltagard
			lambda-cyhalothrin	Lambda, Battle, Demand, Scimitar
			permethrin	Astro
4A	Nicotinic acetylcholine receptor agonists/antagonists	Neonicotinoids	clothianidin	Arena, Aloft
			dinotefuran	Zylam
			imidacloprid	Allectus ² , Imidacloprid, Merit, Mallet, etc.
			thiamethoxam	Meridian
5	Nicotinic acetylcholine allosteric activator	Spinosyns	spinosad	Conserve, Justice Fire Ant Bait
6	Chloride channel activators	Avermectins	abamectin	Affirm, Varsity Fire Ant Bait
7A	Juvenile hormone mimics	Junevile hormone analogues	s-methoprene	Firestrike, Extinguish, Extinguish Plus
7B		Fenoxycarb	fenoxycarb	Award Fire Ant Bait
7C		Pyriproxyfen	pyriproxyfen	Distance Fire Ant Bait
11B1	Microbial disruptors of insect midgut membranes	<i>Bacillus thuringiensis</i>	<i>B.t. var. aizawai</i>	Xentari
11B2			<i>B.t. var. kurstaki</i>	Biobit, Crymax, Dipel, Juvelin, Lepinox
18A	Ecdysone agonists/molting disruptors	Diacylhydrazines	halofenozide	Mach 2
20	Mitochondrial complex III electron transport inhibitors (Coupling Site II)	Hydramethylnon	hydramethylnon	Amdro Firestrike, Extinguish Plus, SiegePro
22A	Voltage-dependent sodium channel blockers	Indoxacarb	indoxacarb	Advion, Provaunt
28	Ryanodine receptor modulator	Diamides	chlorantraniliprole	Acelypryn
un	Unknown MOA	Dicofol	dicofol	Kelthane
uc	Unclassified: Pathogens	Bacteria	<i>Bacillus popillae</i>	Milky spore powder
		Nematodes	<i>Steinernema</i> and <i>Heterorhabditis</i> spp.	Millenium, BioVector, Nemashield
		Fungi	<i>Beauveria bassiana</i>	Botanigard, Naturalis

¹References to commercial products or trade names are made with the understanding that no discrimination is intended and no product endorsement by the University of Minnesota Extension is implied. Any use inconsistent with the label is a violation of Federal law

Insect	Insecticide	Ideal Timing	Comments
White grubs	carbaryl (Sevin)	when grubs are present	Sometimes inconsistent, sensitive to high pH. Very toxic to honey bees.
	chlothianidin (Arena)	when adults are laying eggs	Neonicotinoid May have some curative properties in late summer applications.
	chlorantraniliprole (Acelepryn)	mid April to mid June	Takes 60 days to be effective against white grubs.
	imidacloprid (Merit)	when adults are laying eggs	neonicotinoid Merit went off patent in 2007, many generic forms now available.
	thiamethoxam (Meridian)	when adults are laying eggs	neonicotinoid
	trichlorfon (Dylox)	when grubs are present	Best option to control grubs in spring. Can be used into mid Sept most years. Sensitive high pH.
	Allectus	when adults are laying eggs	combination product – Merit + Talstar
	Aloft	when adults are laying eggs	combination product –chlothianidin and bifenthrin. May have some curative properties in late summer applications.

Scouting: Scout for grubs in early spring or late summer or with soil cores. Check the root/thatch interface for presence of grubs in late July to late August.

Treatment: If using a neonicotinoid, treat when adults are laying eggs (mid-June to late-August). Treat between mid-August and mid-September if grub population averages at least 5 to 10 grubs per square foot. Water in (at least 0.25") immediately after application, but avoid puddling. If population was not controlled in late summer, apply spring control as soon as grubs are near surface, normally in May. Note that some materials have been inconsistent while others have performed consistently well over the years

Insect	Insecticide	Ideal Timing	Comments
Cutworm	bifenthrin (Talstar)	when damage appears	
	carbaryl (Sevin)	when damage appears	Very toxic to honey bees. Repeat applications may be needed, especially after heavy rain.
	chlorantraniliprole (Acelepryn)	mid May to mid June	Several weeks of protection when applied at high label rate.
	chlorpyrifos (Dursban)	when damage appears	Golf course only. Generic formulations only.
	cyfluthrin (Tempo)	when damage appears	
	indoxacarb (Provaunt)	June – July	Often provides several weeks protection.
	spinosad (Conserve)	when damage appears	
	Allectus	June to mid July	combination product – Merit + Talstar
	Aloft	June to mid July	combination product –blend of chlothianidin, bifenthrin.

Scouting: Scout for caterpillars (late in the day or early in the morning) with soapy flushes. **Treatment:** Most cutworms are nocturnal, so treatments are most effective if applied late in the day. Water lightly (less than 0.10"). On golf courses inspect aerification holes throughout summer. Damage often becomes most noticeable shortly after aerification, particularly in late summer.